CHAPTER 16

Interstate System

Interstate System

This chapter describes the Dwight D. Eisenhower System of Interstate and Defense Highways, commonly known as the Interstate System. The Interstate System is the backbone of transportation and commerce in the United States. This chapter provides a snapshot of the physical conditions, operational performance, finance, and investment requirements of the Interstate System. This chapter also represents a supplementary analysis to those of the larger, national road network presented in Chapters 2 through 9 of the report.

Background

On June 26, 1956, President Dwight Eisenhower signed the Federal-Aid Highway Act of 1956, one of his top domestic priorities. President Eisenhower wrote in his memoirs that "more than any single action by the government since the end of the war, this one would change the face of America. Its impact on the American economy—the jobs it would produce in manufacturing and construction, the rural areas it would open up—was beyond calculation."

The 1956 legislation declared that the completion of a "National System of Defense and Interstate Highways" was essential to the national interest. This system was designed to facilitate military transportation during the Cold War, but it had countless other economic and social impacts. The Interstate System, for example, accelerated interstate and regional commerce, increased personal mobility, and led to metropolitan development throughout the United States.

The Federal-Aid Highway Act of 1956 called for new design standards, began an accelerated construction program, and established a new method for apportioning funds among the States. At the same time, the Highway Revenue Act of 1956 introduced a dedicated source for Federal highway expenditures. It created a Federal Highway Trust Fund financed by highway users, allowing massive investment in infrastructure projects. Between 1954 and 2001, the Federal government invested over $387 billion on Interstates through apportionments to the States.

The National Highway System Designation Act of 1995 included the Interstate System as the core of a National Highway System (NHS), described in Chapter 17.

System and Use Characteristics

Exhibit 16-1 describes the total public road length of the Interstate System (data for all roads can be found in Exhibit 2-6). The route miles of the Interstate System in the United States increased from 46,675 in 2000 to 46,747 in 2002. About 70.8 percent (33,107 route miles) were in rural areas, 3.9 percent (1,808 route miles) were in small urban areas, and 25.3 percent (11,832 route miles) were in urbanized areas. By comparison, of the total 3,981,670 route miles for all roads in the United States, 77.4 percent (3,079,757 route miles) were in rural areas, 4.6 percent (183,503 route miles) were in small urban areas, and 18 percent (718,410 route miles) were in urbanized areas.

The number of Interstate route miles in rural areas declined from 33,152 in 2000 to 33,107 in 2002. During the same period, the number of Interstate System miles in small urban areas increased from 1,794

Exhibit 16-1 *Interstate Route and Lane Miles, 1993–2002*

	1993	1995	1997	2000	2002	Annual Rate of Change 2002/1993
Route Miles						
Rural	32,795	32,703	32,919	33,152	33,107	0.1%
Small Urban	1,694	1,731	1,744	1,794	1,808	0.7%
Urbanized	11,313	11,569	11,651	11,729	11,832	0.5%
Total	**45,802**	**46,003**	**46,314**	**46,675**	**46,747**	0.2%
Lane Miles						
Rural	132,559	132,346	133,573	135,000	135,032	0.2%
Small Urban	7,141	7,269	7,365	7,626	7,776	1.0%
Urbanized	62,754	64,865	65,603	67,020	68,088	0.9%
Total	**202,454**	**204,480**	**206,541**	**209,647**	**210,896**	0.5%

Source: Highway Performance Monitoring System.

in 2000 to 1,808 in 2002 and in urbanized areas the number of route miles increased from 11,729 in 2000 to 11,832 in 2002. The decrease in rural route miles is the result of changes in urban boundaries based on the 2000 decennial Census, which caused some formerly rural areas to be reclassified as urban. Note that some States are typically faster than others in modifying their data reporting to correspond to new decennial Census information; consequently, the next edition of the C&P report may show additional rural Interstate mileage having been reclassified as urban.

Between 1993 and 2002, rural Interstate route miles increased by about 0.1 percent annually, small urban Interstate route miles increased at an average annual rate of 0.7 percent, and Interstate route miles in urbanized areas increased 0.5 percent annually. The 0.2 percent overall annual growth rate for Interstates roughly matches that for all roads during that time period.

Exhibit 16-1 also describes the number of Interstate lane miles between 1993 and 2002 (lane mileage data for all functional systems can be found in Exhibit 2-7). In 2002, there were 210,896 lane miles of Interstates in the United States. About 64.0 percent (135,032 lane miles) were in rural communities, 3.6 percent (7,776 lane miles) were in small urban areas, while 32.3 percent (68,088 lane miles) were in urbanized areas. By comparison, about 75.7 percent of all highway lane miles in the United States were in rural areas, 4.7 percent were small urban areas, and 19.6 percent of lane miles were in urbanized areas.

Between 1993 and 2002, rural Interstate lane miles grew by 0.2 percent annually, small urban Interstate lane miles grew at 1.0 percent annually, and urbanized Interstate lane miles grew by 0.9 percent annually. The annual growth rate of lane miles from 1993 to 2002 for the total Interstate System was 0.5 percent annually or almost double the annual growth rate of lane miles for all roads in the United States over the same period. This growth in Interstate lane miles has occurred due to both new construction and the reclassification of some arterials to Interstate status.

Exhibit 16-2 describes the number of Interstate bridges in 1996, 1998, 2000, and 2002. (Data for all bridges can be found in Exhibit 2-15.) Between 1996 and 2002, the number of rural Interstate bridges dropped from 28,638 to 27,316 bridges, while during the same period, the number of urban Interstate bridges increased from 26,596 to 27,929.

Exhibit 16-2 *Number of Interstate Bridges, 1996–2002*

	1996	1998	2000	2002
Rural	28,638	27,530	27,797	27,316
Urban	26,596	27,480	27,882	27,929
Total	**55,234**	**55,010**	**55,679**	**55,245**

Source: National Bridge Inventory.

The reduction in rural bridges is caused in part by the reclassification of some rural Interstates to urban status as communities have grown in size.

Exhibit 16-3 describes vehicle miles traveled (VMT) on Interstate highways between 1993 and 2002. Use data for all roads can be found in Exhibits 2-8, 2-9, and 2-10. In 2002, Americans traveled approximately 282 billion vehicle miles on rural Interstates, 22.6 billion vehicle miles on small urban Interstates, and in excess of 389 billion vehicle miles on urban Interstates. Interstate travel continued to represent the fastest growing portion of VMT between 1993 and 2002. Interstate VMT grew at an average annual rate of approximately 3.1 percent between 1993 and 2002, while VMT on all roads grew by about 2.5 percent annually.

Exhibit 16-3 *Interstate Vehicle Miles Traveled (Annual VMT), 1993–2002 (Millions of VMT)*

	1993	1995	1997	2000	2002	Annual Rate of Change 2002/1993
Rural	209,470	224,705	241,451	269,533	281,461	3.3%
Small Urban	16,297	17,310	18,393	21,059	22,578	3.7%
Urbanized	303,324	327,329	346,376	375,088	389,903	2.8%
Total	**529,091**	**569,345**	**606,220**	**665,681**	**693,941**	3.1%

Source: Highway Performance Monitoring System.

Exhibit 16-4 describes Interstate highway travel by vehicle type between 1993 and 2002. In 2002, 80.5 percent of travel on rural Interstates was by passenger vehicle; 3.1 percent was by single-unit truck; and 16.4 percent was by combination truck. About 91.9 percent of urban Interstate travel was by passenger vehicle; 2.2 percent was by single-unit truck; and 5.9 percent was by combination truck. By contrast, passenger vehicle travel represented 92.5 percent of travel on all roads in 2002. Single-unit truck travel represented 2.6 percent of travel, and combination truck travel represented 4.9 percent.

Exhibit 16-4 *Annual Interstate Miles Traveled by Vehicle Type, 1993–2002 (Millions of VMT)*

	1993	1995	1997	2000	2002	Annual Rate of Change 2002/1993
Rural						
PV	169,500	180,031	188,969	214,175	224,375	3.2%
SU	5,982	6,708	7,667	8,260	8,745	4.3%
Combo	32,826	36,644	41,642	44,377	45,633	3.7%
Urban						
PV	294,703	315,888	330,668	358,906	373,957	2.7%
SU	6,513	7,148	7,906	8,719	9,106	3.8%
Combo	16,183	18,492	20,641	23,472	23,887	4.4%

PV = Passenger vehicles (including buses and 2-axle, 4-tire vehicles)

SU = Single Unit Trucks (6 tires or more)

Combo = Combination Trucks (trailers and semi-trailers)

Note: Table does not include VMT for Puerto Rico

Source: Highway Statistics, Summary to 1995, Table VM-201; Highway Statistics, 1997, VM-1; November

Travel on rural and urban Interstates grew faster than on any other functional system. Between 1993 and 2002, for example, combination truck travel grew by 4.4 percent annually on urban Interstates and by 3.7 percent on rural Interstates. By comparison, combination truck travel on all roads increased by 3.3 percent annually between 1993 and 2002.

Physical Conditions

Chapter 3 describes the physical conditions of highways throughout the United States. There are numerous ways to examine physical conditions. This section focuses on Interstate pavement condition, lane width, alignment adequacy, bridge deficiencies, and bridge age.

Pavement Condition

Exhibit 16-5 shows the percentage of total Interstate miles with "Acceptable" or better ride quality by function class for select years from 1995 to 2002. *Exhibit 16-6* shows the percentage of Interstate pavement meeting a standard of "Good" ride quality. (Data for other functional systems can be found in Exhibit 3-14.) Since 1995, the number of Interstate miles rated as having "Good" ride quality has increased for all three population subsets of Interstate highways.

Exhibit 16-5 *Percent of Interstate Miles with Acceptable Ride Quality, 1995–2002*

Location of Interstates	1995	1997	1999	2000	2002
Rural Areas	94.5%	95.9%	97.6%	97.8%	97.8%
Small Urban Areas	94.4%	95.8%	95.4%	95.7%	95.3%
Urbanized Areas	90.0%	90.0%	92.2%	93.0%	91.7%

Source: Highway Performance Monitoring System.

Exhibit 16-6 *Percent of Interstate Miles with Good Ride Quality, 1995–2002*

Location of Interstates	1995	1997	1999	2000	2002
Rural Areas	51.8%	56.9%	65.4%	68.5%	71.9%
Small Urban Areas	49.8%	51.4%	58.2%	61.6%	64.9%
Urbanized Areas	41.4%	39.3%	45.0%	48.2%	48.7%

Source: Highway Performance Monitoring System.

In 2002, rural area Interstates had the greatest percentage of miles with "Acceptable" or better ride quality. About 98 percent of rural area Interstates met this standard. As a subset of the miles with "Acceptable" ride quality, 71.9 percent of rural Interstate miles met standards required for classification as "Good" ride quality.

For small urban Interstate miles, 95.3 percent met the criteria for "Acceptable" ride quality. As a subset of the miles with "Acceptable" ride quality, 64.9 percent met the standards to be classified as "Good" ride quality in the year 2002.

Q. How has the percent of Interstate travel occurring on pavements with "Acceptable "and "Good" ride quality changed since 1995?

A. As discussed in Chapter 3, another way to evaluate ride quality is to consider the vehicle miles traveled on routes with "Acceptable" or "Good" ride quality, rather than simply looking at the miles of pavement themselves (see Exhibit 3-15). On this basis, the percentage of rural Interstate travel on pavements with "Acceptable" ride quality rose from 94.5 percent in 1995 to 97.3 percent in 2002, while the percentage of travel on pavements with "Good" ride quality rose from 53.3 percent to 72.2 percent.

Conditions also improved for urbanized Interstates, as the percentage of travel on pavements with "Acceptable" ride quality rose from 88.8 percent to 89.3 percent, while the percentage of travel on pavements with "Good" ride quality rose from 39.1 percent to 43.8 percent.

For small Urban Interstates, performance was mixed, as the percentage of travel on pavements with "Acceptable" ride quality declined from 94.9 percent to 94.6 percent, while the percentage of travel on pavements with "Good" ride quality rose from 51.4 percent to 65.1 percent.

In 2002, 91.7 percent of urbanized Interstate miles met the criteria for "Acceptable" ride quality. As a subset of this group meeting "Acceptable" ride quality, 48.7 percent of the urbanized Interstate miles met the standards to be classified as having "Good" ride quality.

Lane Width, Alignment, and Access Control

As described in Chapter 3, roadway alignment affects the level of service and safety of the highway system. Inadequate alignment may result in speed reductions as well as impaired sight distance. In particular, trucks are affected by inadequate roadway alignment with regard to speed.

There are two types of alignment: horizontal (curvature) and vertical (gradient). Alignment adequacy is evaluated on a scale from Code 1 (best) to Code 4 (worst). *Exhibit 16-7* summarizes alignment for rural Interstates (alignment is normally not an issue in urban areas). More than 93.3 percent of rural Interstate miles are classified as Code 1 for vertical and 95.7 percent are classified as Code 1 for horizontal alignment.

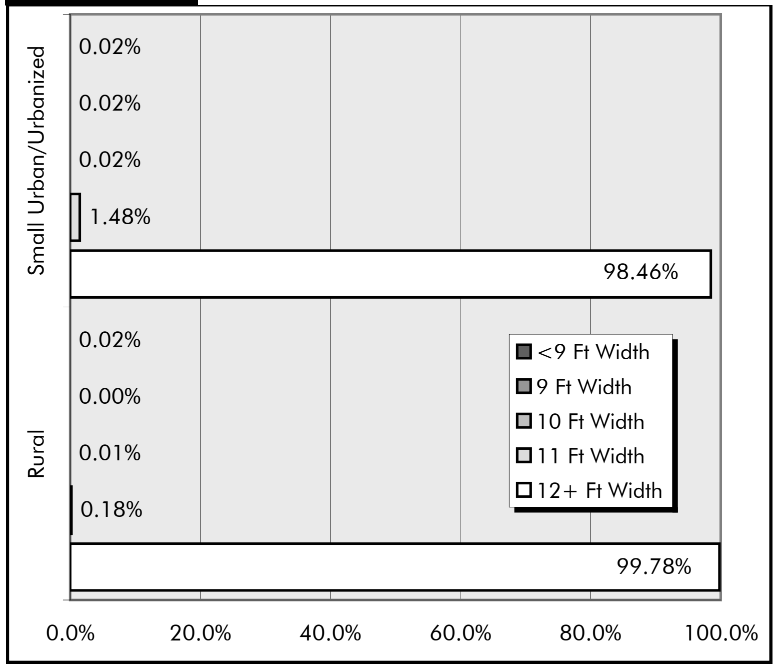
Exhibit 16-7 *Rural Interstate Vertical/Horizontal Alignment Status for 2002 (Percent of Miles)*

		Vertical	Horizontal
Code 1:	All curves and grades meet appropriate design standards.	93.3%	95.7%
Code 2:	Some curves or grades are below design standards for new construction, but curves can be negotiated safely at prevailing speed limits. Truck speed is not substantially affected.	5.9%	1.1%
Code 3:	Infrequent curves or grades occur that impair sight distance or severely affect truck speeds. May have reduced speed limits.	0.3%	0.8%
Code 4:	Frequent grades occur that impair sight distance or severely affect truck speeds. Generally, curves are unsafe or uncomfortable at prevailing speed limit, or the speed limit is severely restricted due to the design speed limits of the curves.	0.5%	2.4%

Source: Highway Performance Monitoring System.

Lane width can have an impact on highway safety and operational performance. Currently, higher functional systems such as Interstates are expected to have 12-foot lanes. As shown in *Exhibit 16-8,* approximately 99.8 percent of rural Interstate miles and 98.5 percent of urban Interstate miles have minimum 12-foot lanes widths (see also Exhibits 3-19 and 3-20 in Chapter 3).

Exhibit 16-8 *Interstate Lane Width*



Source: Highway Performance Monitoring System.

The vast majority of the Interstate mileage consists of divided highways with a minimum of four lanes and with full access control. The Interstate Systems for Alaska and Puerto Rico are not required to meet this standard. For Alaska and Puerto Rico, the requirement is that construction is adequate for current and probable future traffic demands and the needs of the locality. In Alaska, 1,034 miles of rural Interstate are not required to have a minimum of four lanes and full access control. For urban Interstates, 104 miles do not meet the specified criteria for access control; 53 of these miles are in Puerto Rico and the remaining miles are in Alaska.

Bridge Conditions

Exhibit 3-33 in Chapter 3 identifies bridge deficiencies by functional system, while Exhibit 3-35 shows the percentage of rural and urban bridge deficiencies for the Interstate System in particular. Approximately 15.8 percent of all rural Interstate bridges were deficient in 2002, including 1,104 that were structurally deficient (about 4.0 percent of the total number) and 3,210 that were functionally obsolete (11.8 percent of the total number). Among rural functional systems, only other principal arterials had a lower percentage of bridge deficiencies.

About 26.3 percent of all urban Interstate bridges were deficient in 2002. This included 1,715 structurally deficient bridges (6.1 percent of total urban Interstate bridges), and 5,617 functionally obsolete bridges (20.1 percent of the total). Among urban functional systems, the Interstate System had the lowest percentage of deficient bridges.

The number of deficient bridges has steadily declined in recent years. In 1994, for example, 18.5 percent of rural Interstate bridges were deficient. That number has declined to 15.8 percent. The number of deficient urban Interstate bridges also declined, from 30.6 percent in 1994 to 26.3 percent.

The Federal Highway Administration also looks at bridge deficiencies by the percent of deficient deck area. Approximately 17.9 percent of the rural Interstate bridge deck area was deficient in 1996. This has decreased to 14.6 percent in 2002. This is the lowest percent deficient deck area for all rural functional classes.

The percent of deficient deck area on urban Interstate bridges was 34.2 percent in 1996. By 2002, this had decreased to 31.0 percent.

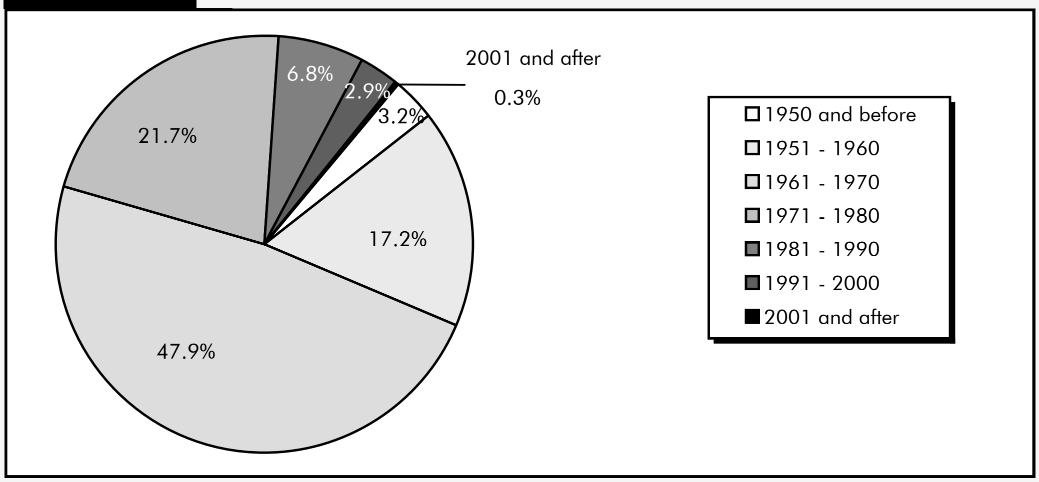
Q. How old are most Interstate bridges?

A. The aging of Interstate bridges is a significant concern for the Federal Highway Administration and its State and local partners.

Exhibit 16-9 describes the age of rural Interstate bridges. About 47.9 percent of rural Interstate bridges were built during the early years of the Interstate System, from 1961 to 1970. More than 68.2 percent of all rural Interstate bridges in 2002 were at least 30 years old.

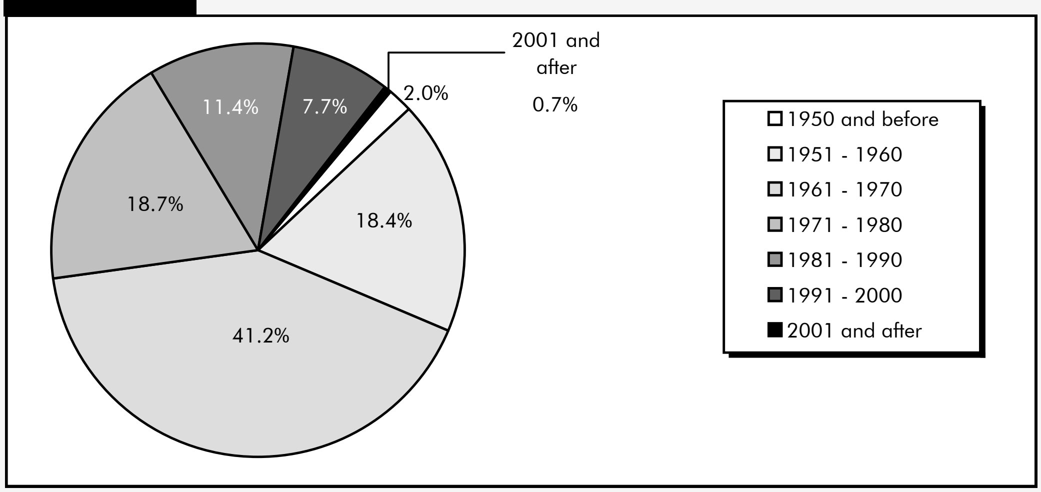
Exhibit 16-10 describes the age of urban Interstate bridges. About 41.2 percent of urban Interstate bridges were built between 1961 and 1970. Over 61.5 percent of all urban Interstate bridges in 2002 were at least 30 years old.

Exhibit 16-9 *Age Composition of Rural Interstate Bridges, 2002*



Source: National Bridge Inventory.

Exhibit 16-10 *Age Composition of Urban Interstate Bridges, 2002*



Source: National Bridge Inventory.

Operational Performance

As discussed in Chapter 4, the operational performance of the highway system has been declining in urbanized areas based on a variety of measures.

The Percent of Additional Travel Time, Annual Hours of Delay, and Percent of Travel Under Congested Conditions measures highlighted in Chapter 4 are not computed separately by functional class. However, the Daily Vehicle Miles Traveled (DVMT) per Lane Mile statistics shown in Exhibits 4-12 through 4-14 show the increasing demands being placed on the Interstate System.

From 1993 to 2002, DVMT per lane mile increased from 4,329 to 5,711 on rural Interstate highways, from 6,252 to 7,955 on small urban Interstate highways and from 13,243 to 15,689 on Interstate highways in urbanized areas.

Safety

Exhibits 16-11 and *16-12* describe the number of fatalities and the fatality rate for Interstates between 1994 and 2002. While the number of fatalities has increased on both rural and urban Interstates, these roads are still safer on average than those in other functional classes. The fatality rate on rural Interstates has remained lower than any other rural functional class, and the fatality rate on urban Interestates has remained the lowest of any functional class. More detailed information about highway safety can be found in Chapter 5.

Exhibit 16-11 *Number of Fatalities on the Interstate System, 1994–2002*

	1994	1996	1998	2000	2002
Rural Interstates	2,566	2,924	3,105	3,254	3,298
Urban Interstates	2,147	2,321	2,283	2,419	2,482

Source: Fatality Analysis Reporting System.

The rural Interstate fatality rate was almost double that of urban Interstates for the period from 1994 to 2002. This is consistent with the statistics presented in Chapter 5, which showed that fatality rates are generally higher in rural areas.

Exhibit 16-12 *Fatality Rates (per 100 Million VMT) on the Interstate System, 1994–2002*

	1994	1996	1998	2000	2002
Rural Interstates	1.19	1.26	1.23	1.21	1.18
Urban Interstates	0.65	0.66	0.61	0.61	0.61

Source: Fatality Analysis Reporting System.

Finance

All levels of government spent $17.1 billion for capital improvements on Interstate highways and bridges in 2000, which constituted 25.1 percent of the $68.2 billion of capital outlay on all functional classes. *Exhibit 16-13* categorizes this total by type of improvement. System preservation expenditures constituted 53.0 percent of total capital spending on Interstates, system expansion 38.2 percent, and system enhancements 8.8 percent. See Chapter 6 for definitions of these three broad categories of improvement types.

Exhibit 16-13 *Interstate Capital Expenditures, 2002*

	Total Invested (Billions of Dollars)			Percent of Total Interstate	Percent of Total for all Functional Classes		
	Rural	Urban	Total		Rural	Urban	Total
System Preservation							
Highway Preservation	$2.8	$3.1	$5.9	34.5%	11.4%	12.7%	24.1%
Bridge Preservation	$1.2	$1.9	$3.2	18.5%	10.9%	17.3%	28.1%
Subtotal	**$4.0**	**$5.1**	**$9.1**	**53.0%**	**11.2%**	**14.1%**	**25.3%**
System Expansion							
Additions to Existing Roadways	$1.6	$2.0	$3.7	21.3%	12.0%	14.9%	26.9%
New Routes	$0.5	$2.2	$2.7	15.8%	4.6%	18.4%	23.0%
New Bridges	$0.0	$0.2	$0.2	1.0%	1.8%	13.8%	15.6%
Subtotal	**$2.2**	**$4.3**	**$6.5**	**38.2%**	**8.3%**	**16.4%**	**24.7%**
System Enhancements	**$0.4**	**$1.1**	**$1.5**	**8.8%**	**6.7%**	**18.9%**	**25.5%**
Total Investment	**$6.6**	**$10.5**	**$17.1**	**100.0%**	**9.7%**	**15.4%**	**25.1%**

Sources: Highway Statistics 2002, Table SF-12A and unpublished FHWA data.

Capital investment on Interstate highways increased sharply between 2000 and 2002, rising 21.6 percent; while total capital investment on all functional classes rose by only 11.2 percent. *Exhibit 16-14* shows that rural Interstate spending rose by 48.2 percent between these two years, driven by an increase in rural Interstate bridge preservation of 181.5 percent and rural Interstate widening of 137.3 percent.

It is important to note that for a particular functional class (such as rural Interstates) and a particular type of capital improvement (such as bridge preservation), year-to-year spending is much more variable than for total capital investment of all types and can be more easily affected by large individual projects that happen to have a high level of cash outlays in a given year. It would be premature to suggest that the changes in expenditure patterns observed between 2000 and 2002 represent a long-term trend. This comparison is included primarily to help put into perspective the comparisons of 2002 spending with future capital investment requirements discussed later in this chapter.

Exhibit 16-14 *Interstate Capital Expenditures, 2002 Versus 2000*

	2000 (Billions of Dollars)			2002 (Billions of Dollars)			Percent Change 2002 Versus 2000		
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
System Preservation									
Highway Preservation	$2.8	$3.2	$5.9	$2.8	$3.1	$5.9	0.8%	-1.4%	-0.3%
Bridge Preservation	$0.4	$1.2	$1.6	$1.2	$1.9	$3.2	181.5%	62.0%	93.7%
Subtotal	**$3.2**	**$4.4**	**$7.6**	**$4.0**	**$5.1**	**$9.1**	**25.3%**	**16.1%**	**20.0%**
System Expansion									
Additions to Existing Roadways	$0.7	$1.8	$2.5	$1.6	$2.0	$3.7	137.3%	11.4%	46.0%
New Routes	$0.3	$2.4	$2.7	$0.5	$2.2	$2.7	87.0%	-8.6%	1.7%
New Bridges	$0.0	$0.4	$0.4	$0.0	$0.2	$0.2	-23.4%	-58.9%	-56.6%
Subtotal	**$1.0**	**$4.6**	**$5.6**	**$2.2**	**$4.3**	**$6.5**	**118.6%**	**-4.8%**	**17.4%**
System Enhancements	**$0.2**	**$0.7**	**$0.9**	**$0.4**	**$1.1**	**$1.5**	**60.2%**	**58.3%**	**58.8%**
Total Investment	**$4.5**	**$9.6**	**$14.1**	**$6.6**	**$10.5**	**$17.1**	**48.2%**	**9.2%**	**21.6%**

Sources: Highway Statistics 2002, Table SF-12A and unpublished FHWA data.

Capital Investment Requirements

Exhibits 7-2 and 7-3 in Chapter 7 show the estimated average annual Maximum Economic Investment (Cost to Improve Highways and Bridges) and Cost to Maintain Highways and Bridges for 2003-2022, categorized by functional class and improvement type. For the Maximum Economic Investment scenario, investment requirements for rural and urban Interstates total $6.4 billion (5.4 percent of total) and $24.9 billion (20.9 percent of the total), respectively. At this level of investment, all cost-beneficial improvements would be implemented. See Chapter 7 and Appendix A for more on the investment requirements methodology used in this report.

For the Cost to Maintain scenario, the portion of estimated investment requirements on Interstates totals $5.0 billion for rural and $13.8 billion for urban. These amounts are 6.7 and 18.7 percent, respectively, of the total Cost to Maintain Highways and Bridges. At this level of investment, average user costs on all highways in 2022 would be maintained at their 2002 levels. User costs would increase on some sections and functional classes and would decrease on others. In the case of Interstate highways, average user costs in both urban and rural areas would decrease slightly.

Exhibits *16-15* through *16-18* show the impacts of different levels of future capital spending on the physical conditions and operational performance of rural and urban Interstates. The first line in each exhibit shows current values for each of the measures, and the second line corresponds to the maximum economically efficient level of investment. All investment levels are in constant 2002 dollars.

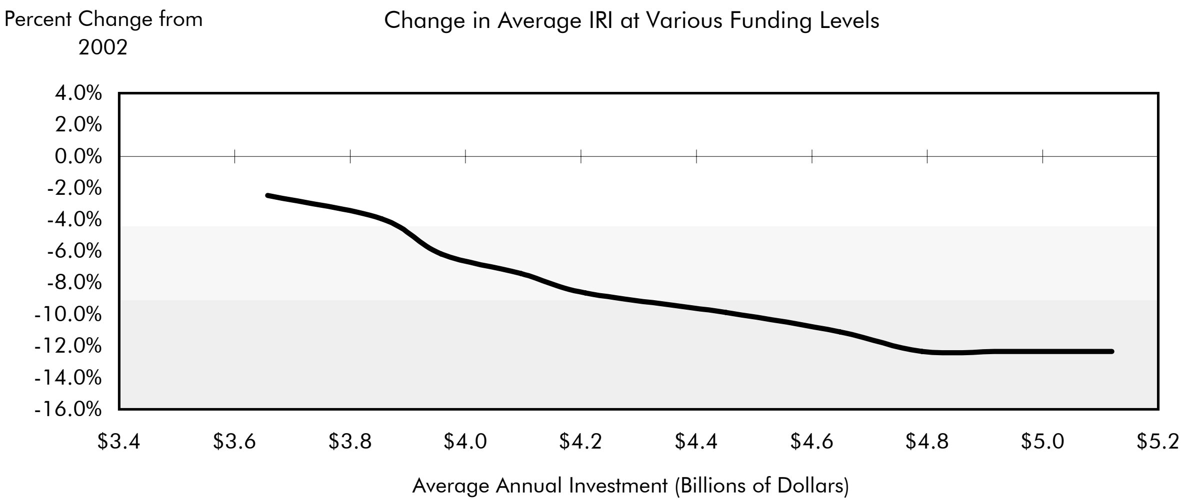
Exhibits 16-15 and 16-17 show the impact of different levels of combined highway preservation and expansion spending on pavement condition, and Exhibits 16-16 and 16-18 show the impact of these same outlays on measures of operational performance. Highway preservation and system expansion investment requirements are modeled by the Highway Economic Requirements System (HERS) (see Appendix A).

Expenditures on system enhancements (including traffic operational improvements, safety improvements and environmental enhancements) are not directly modeled and are not included in the totals shown in the exhibits. Bridge preservation investment requirements are discussed separately below.

Rural Interstates

Exhibit 16-15 shows projected values for average International Roughness Index (IRI), a measure of average pavement condition, and the percentage of VMT at an IRI below 95 and below 170. These two levels are used to define "Good" and "Acceptable" levels of pavement ride quality. (Chapter 3 provides more information on how pavement condition is defined.) The exhibit shows that the 2002 preservation and expansion investment level of $4.99 billion on rural highways is only slightly below the maximum economic investment level of $5.12 billion estimated by HERS.

Exhibit 16-15 *Projected Rural Interstate Pavement Condition in 2022 for Different Possible Funding Levels*



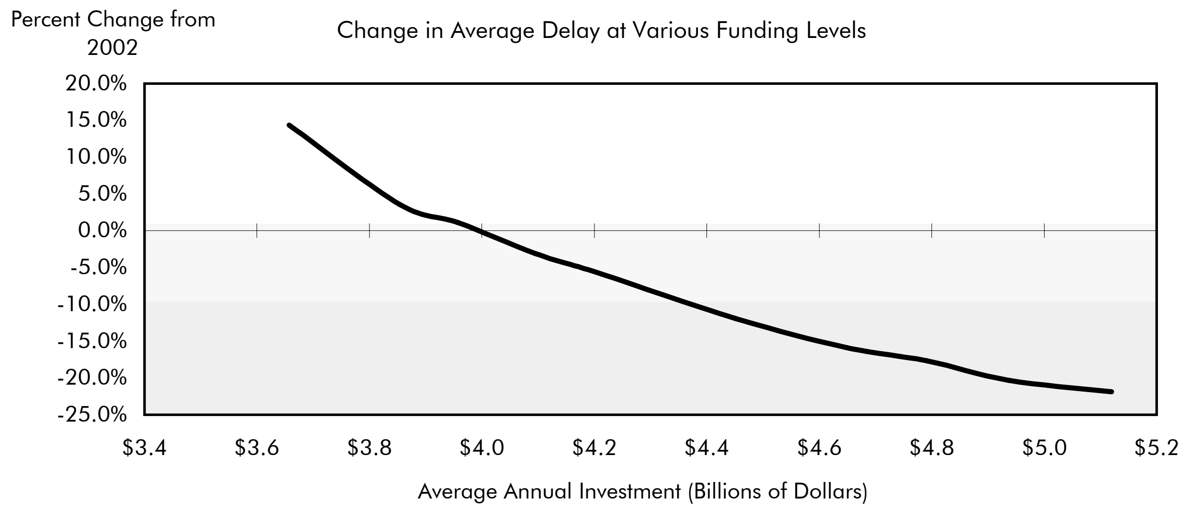
Average Annual Highway Preservation + Expansion Investment (Rural Interstates) (Billions of 2002 Dollars)	Percent Change in Average IRI	Percent of VMT on Roads with IRI<95	IRI<170	Funding Level Description: Investment Required to...
$4.99		**73.5%**	**97.3%**	2002 Values
$5.12	-12.3%	86.5%	100.0%	
$4.94	-12.3%	85.9%	99.9%	
$4.79	-12.3%	85.4%	99.9%	
$4.65	-11.1%	84.4%	99.9%	
$4.45	-9.9%	82.4%	99.8%	
$4.21	-8.6%	79.9%	99.7%	
$4.10	-7.4%	78.3%	99.5%	
$3.96	-6.2%	76.3%	99.4%	
$3.85	-4.0%	74.6%	99.3%	...Maintain VMT with IRI<95
$3.66	-2.5%	71.5%	99.1%	...Maintain Average IRI

Source: Highway Economic Requirements System.

If current funding levels were sustained, and the mix of highway preservation and widening investments recommended by HERS were implemented, then average IRI would be projected to decline by 12.3 percent over 20 years, and the percentage of travel on roads with good pavement quality would rise to 86 percent. Virtually all travel on rural Interstates would occur on roads with at least acceptable ride quality. The annual level of funding required to maintain Average IRI is below $3.66 billion.

Exhibit 16-16 shows how future values for average delay per VMT (discussed in Chapter 9), total user costs, and travel time costs on rural Interstates would be affected by different levels of highway preservation and expansion investment. Average user costs on rural Interstates would be maintained at an average annual investment level of $3.66 billion, while average travel time costs would decrease at that funding level. Average delay on rural Interstates would be maintained at an investment level between $3.96 and $4.10 billion, and would decline by over 20 percent at 2002 preservation and expansion expenditure levels.

Exhibit 16-16 *Projected Rural Interstate Conditions and Performance in 2022 for Different Possible Funding Levels*



Average Annual Highway Preservation + Expansion Investment (Rural Interstates) (Billions of 2002 Dollars)	Percent Change in: Average Total Delay	Total User Costs	Travel Time Costs	Funding Level Description: Investment Required to...
$4.99				2002 Values
$5.12	-21.9%	-0.9%	-2.9%	
$4.94	-20.3%	-0.9%	-2.6%	
$4.79	-17.7%	-0.8%	-2.6%	
$4.65	-15.9%	-0.8%	-2.3%	
$4.45	-11.9%	-0.7%	-2.3%	
$4.21	-5.7%	-0.5%	-1.6%	
$4.10	-3.1%	-0.4%	-1.6%	…Maintain Average Delay
$3.96	1.1%	-0.3%	-1.3%	
$3.85	3.5%	-0.2%	-0.8%	
$3.66	14.3%	0.0%	-0.3%	…Maintain Average User Costs
				…Maintain Average Travel Time Costs

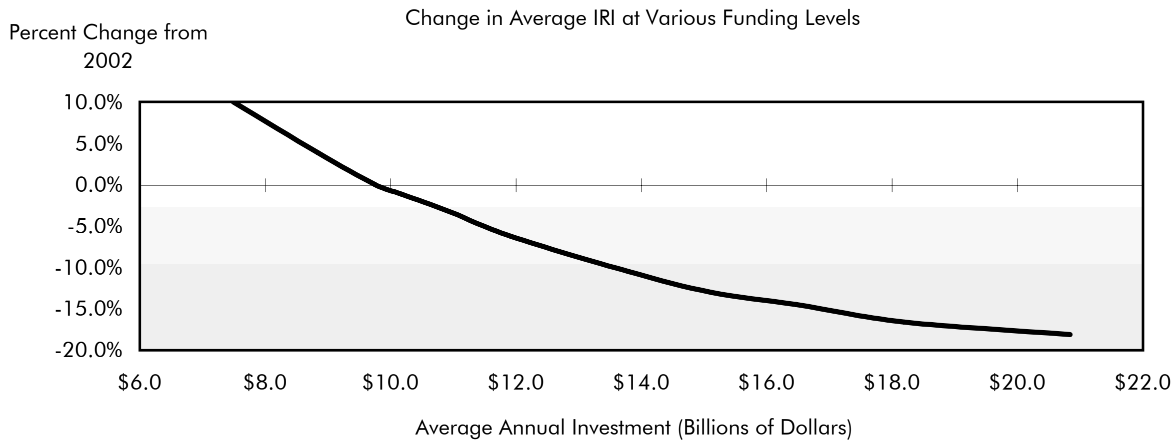
Source: Highway Economic Requirements System.

If current funding levels were sustained, and the mix of highway preservation and widening investments recommended by HERS were implemented, then significant reductions could be achieved in average total delay, total user costs and total travel time costs. However, as noted above, spending for additions to existing rural Interstates rose 137.3 percent between 2000 and 2002. If future spending reverts back to a level more in line with what was observed in 2000, then average total delay would be expected to increase.

Urban Interstates

Exhibits 16-17 and 16-18 show the impacts on the same measures of conditions and performance for different levels of capital spending on urban Interstates. Exhibit 16-17 shows that an average annual highway preservation investment of approximately $10.0 billion would be required to maintain average IRI at 2002 levels. As with rural Interstates, the percentage of travel on urban Interstate pavements with good ride quality would increase at this level of investment, while investment would need to increase to over $12 billion to maintain the percentage of VMT on roads with acceptable ride quality.

Exhibit 16-17 *Projected Urban Interstate Pavement Condition in 2022 for Different Possible Funding Levels*



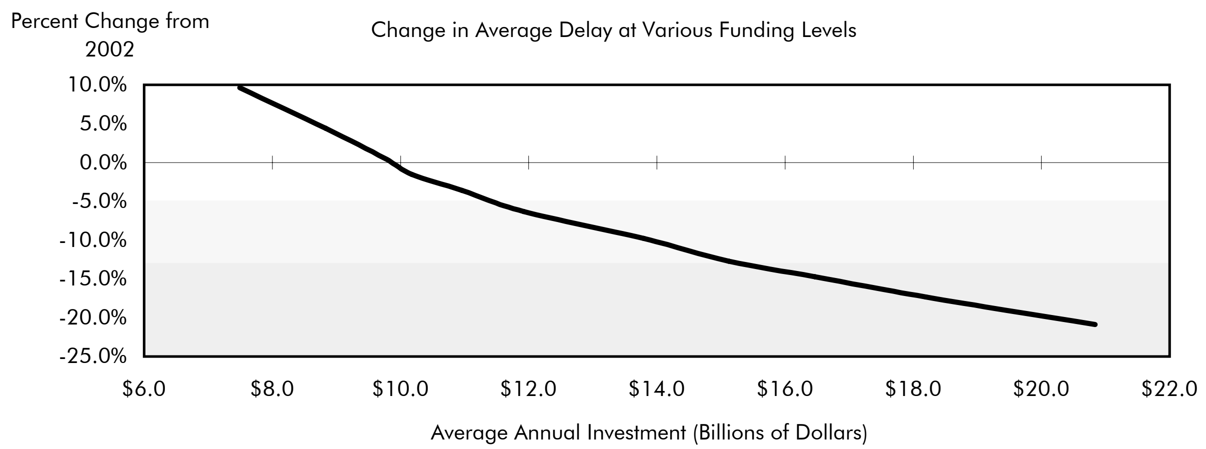
Average Annual Highway Preservation + Expansion Investment (Urban Interstates) (Billions of 2002 Dollars)	Percent Change in Average IRI	Percent of VMT on Roads with IRI<95	IRI<170	Funding Level Description: Investment Required to...
$7.46		**45.6%**	**90.0%**	2002 Values
$20.84	-18.1%	72.7%	93.7%	
$18.20	-16.6%	70.7%	93.0%	
$16.47	-14.5%	68.9%	92.2%	
$15.12	-13.0%	67.2%	91.8%	
$13.80	-10.5%	64.5%	91.1%	...Maintain VMT with IRI<170
$11.92	-6.2%	61.0%	89.7%	
$10.96	-3.2%	57.5%	89.0%	
$10.18	-1.1%	55.4%	87.9%	...Maintain Average IRI
$9.75	0.1%	54.3%	87.6%	
$8.83	4.0%	51.6%	86.1%	
$7.49	10.1%	47.8%	81.8%	

Source: Highway Economic Requirements System.

If current funding levels were sustained, and the mix of highway preservation and widening investments recommended by HERS were implemented, then average IRI on urban Interstates would be expected to increase by 10.1 percent, and the percent of VMT on roads with acceptable ride quality would fall to 81.8 percent. The results suggest that a substantial increase in urban Interstate investment would be necessary to prevent average pavement condition on urban Interstates from deteriorating in the future.

Exhibit 16-18 indicates that an average annual investment level in highway preservation and capacity expansion of between $9.75 and $10.18 billion would be needed to maintain average delay on urban Interstates. Total user costs would be maintained at investment levels up to $10.96 billion, and travel time costs on urban Interstates would be maintained at funding levels over $12 billion. These amounts are 30 to 70 percent higher than the comparable 2002 funding level of $7.5 billion. The results suggest that, if average annual funding were maintained (in constant dollars) at 2002 levels through 2022, average delay on urban Interstates would increase by 9.6 percent, total user costs would increase by 4.1 percent, and travel time costs would increase by 9.6 percent.

Exhibit 16-18 *Projected Urban Interstate Conditions and Performance in 2022 for Different Possible Funding Levels*



Average Annual Highway Preservation + Expansion Investment (Urban Interstates) (Billions of 2002 Dollars)	Percent Change in Average Total Delay	Percent Change in Total User Costs	Percent Change in Travel Time Costs	Funding Level Description: Investment Required to...
$7.46				2002 Values
$20.84	-20.9%	-5.9%	-6.8%	
$18.20	-17.3%	-5.0%	-5.3%	
$16.47	-14.7%	-4.2%	-4.0%	
$15.12	-12.7%	-3.6%	-2.9%	
$13.80	-9.8%	-2.8%	-1.7%	...Maintain Average Travel Time Costs
$11.92	-6.3%	-1.4%	0.5%	
$10.96	-3.6%	-0.5%	2.0%	...Maintain Average User Costs
$10.18	-1.5%	0.3%	3.2%	...Maintain Average Delay
$9.75	0.6%	0.7%	4.0%	
$8.83	4.4%	1.9%	5.9%	
$7.49	9.6%	4.1%	9.6%	

Source: Highway Economic Requirements System.

Bridge Preservation

As described in Chapter 7, the National Bridge Investment Analysis System model identifies preservation investment requirements for all bridges, including those on Interstates. The current Interstate bridge preservation backlog is estimated at $14.2 billion.

Exhibit 16-19 describes what the Interstate bridge backlog after 20 years would be at different funding levels. An average annual investment in bridge preservation of $2.13 billion is required so that the Interstate bridge investment backlog would not increase above its current level over a 20-year period. An average annual investment of $2.82 billion would be sufficient to eliminate the existing Interstate bridge investment backlog and correct other deficiencies that are expected to develop over the next 20 years, where it is cost-beneficial to do so.

Exhibit 16-19 *Projected Interstate Bridge Investment Backlog in 2022 for Different Possible Funding Levels*

(Billions of 2002 Dollars)	
Average Annual Investment	**2022 Interstate Bridge Backlog**
$2.82	$0.0
$2.65	$3.9
$2.50	$6.7
$2.27	$11.2
$2.13	$14.2
$1.96	$17.7
$1.65	$24.2
$1.38	$31.1

Source: National Bridge Investment Analysis System.

Exhibit 16-13 indicates that bridge preservation expenditures on Interstates totaled $3.2 billion in 2002. Thus, if this level of funding were maintained in constant dollars over 20 years, NBIAS projects that the Interstate bridge backlog could be eliminated. However, Exhibit 16-14 shows that Interstate bridge preservation spending rose 93.7 percent from $1.6 billion to $3.2 billion between 2000 and 2002. If future spending reverts back to a level more in line with what was observed in 2000, then the Interstate bridge preservation backlog would increase significantly.

Current Spending Versus Investment Requirements

Exhibits 16-15 through 16-19 indicate that 2002 levels of highway preservation and system expansion investment on rural Interstates are above the levels necessary to maintain conditions and performance in the future, although there remain significant opportunities for cost-beneficial improvements to the system. The 2002 level of rural and urban Interstate bridge preservation investment would be adequate to address the economic backlog of bridge deficiencies, if that level of investment could be sustained. However, as shown in Exhibit 16-14 and discussed previously, 2002 may represent an unusually high year for rural Interstate capital spending, especially for rural bridges.

On urban Interstates, significant increases in funding for preservation and expansion above current levels would be required to prevent both average physical conditions and operational performance from becoming degraded.